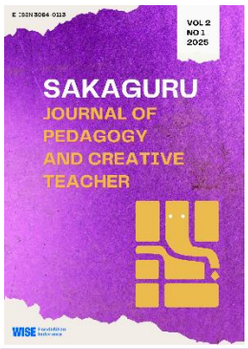

SAKAGURU
JOURNAL OF PEDAGOGY AND CREATIVE TEACHER
VOL. 2 NO. 1 (2025)

ISSN: 3064-0113

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To cite this article Sari, A. A., Ayu, S. N., & Manaasika, Z. (2025). Development of UI / UX Based Microlearning to Prevant Misconception in Physics Learning with Computational Thinking Approach. *SAKAGURU J. Pedagog. Creat. Teach*, *2*(1), 71–80. https://doi.org/10.70211/sakaguru.v2n1.206

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https://doi.org/10.70211/sakaguru.v2n1.206

SAKAGURU: Journal of Pedagogy and Creative Teacher Vol 2 No 1 (2025)

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Research Article

Development of UI/UX Based Microlearning to Prevant Misconception in Physics Learning with Computational Thinking Approach

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Received : January 24, 2025	Revised : March 08, 2025	Accepted : April 28, 2025	Online : May 26, 2025

Abstract

Physics learning is often faced with the challenge of the complexity of abstract concepts, potentially causing misconceptions in students. This research aims to develop microlearning learning media based on User Interface (UI) and User Experience (UX) to prevent misconceptions in thermodynamics material, with a computational thinking (CT) approach. This research uses the Research and Development (R&D) method that adapts the Borg and Gall model, but is limited to the product design stage. The media was developed through the stages of identifying potential and problems, literature review, and prototype design using the Figma platform. The development results show that UI/UX-based microlearning can present material in a concise, interactive, and adaptive manner in accordance with the learning characteristics of the digital generation, and support the formation of algorithmic mindset through concept decomposition and visualization. Although this research has not involved empirical effectiveness testing, the media design shows significant potential in improving concept understanding and preventing misconceptions. Further research is recommended to complete the R&D stage to test the impact on physics learning outcomes as a whole.

Keywords: Computational Thinking; Microlearning; Misconceptions; Physics Learning; UI/UX

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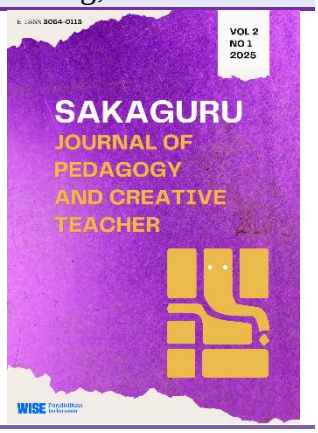

INTRODUCTION

Physics as one of the branches of science has unique characteristics, especially regarding abstract and mathematical concepts that demand in-depth understanding from students [1]. Various studies show that cognitive skills and good conceptual understanding are very important for students to be able to understand complex physics concepts. [2] stated that the use of virtual simulation media in interactive conceptual learning approaches can further increase its effectiveness in improving students' concept understanding and minimizing misconceptions.

However, in practice, misconceptions become one of the main problems in physics learning. Misconceptions are formed when the concept built by learners deviates from the correct concept or what the educator expects [3]. [4] noted that to prevent misconceptions in physics learning, a more interactive and explorative approach is needed, which allows students to build a deep understanding of physics concepts.

One of the latest trends in education is the development of microlearning, as a learning model that allows the learning process to take place in a shorter duration, focusing on the essence, and supporting the expansion of access to learning content flexibly [5]. This learning is generally presented in multimodal formats such as images, audio, and video to increase learners' absorption of the information presented [6]. These characteristics make microlearning relevant to be applied in the context of physics learning which is full of complex and abstract concepts, so that it can help learners in building understanding gradually and more structured. Several studies show that microlearning can contribute significantly to reducing cognitive load and improving learning outcomes in complex fields such as physics, compared to conventional teaching [7], [8]. By integrating immediate feedback in learning, microlearning not only strengthens knowledge retention but also increases learners' learning motivation [9]. However, in its development, the effectiveness of microlearning depends on how the content is presented and accessed by learners.

Therefore, the integration of good user interface (UI) and user experience (UX) design is crucial [10], as it not only emphasizes learner engagement, but also the emotional and contextual nuances that shape their learning experience [11]. In addition, this research also integrates the Computational Thinking (CT) approach to assist learners in overcoming misconceptions by breaking complex concepts into smaller parts that are easier to understand. In line with this, the problem formulations raised in this study are: How to Develop UI/UX-Based Microlearning Learning Media to Prevent Misconceptions in Physics Learning with Computational Thinking Approach? Based on the formulation of the problem, the purpose of this research is to know the process of developing UI/UX-based microlearning learning media to prevent misconceptions in physics learning with a computational thinking approach. This research is expected to not only contribute to innovative development but also offer new perspectives in learning design.

METHODS

This research uses the Research and Development model or in English terms Research and Development (R&D). Research and Development is a research method used to produce a certain product and test the effectiveness of the product [12]. This model was chosen because it

is suitable for developing innovative products that can solve classroom learning problems. The product developed in this research is UI/UX-based microlearning learning media on thermodynamic material.

Product Development Steps

The development model in this study follows specific stages in the R&D process, following the model established by Borg and Gall [13]. This model consists of ten systematic steps, namely: (1) identification of potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product trial, (7) product revision, (8) usage trial, (9) product revision and finally (10) mass production. However, this research is limited to only the third stage, namely product design. This is because it is in accordance with the formulation of the problem in this study [14]. The following scheme of the stages in this study can be seen in Figure 1.

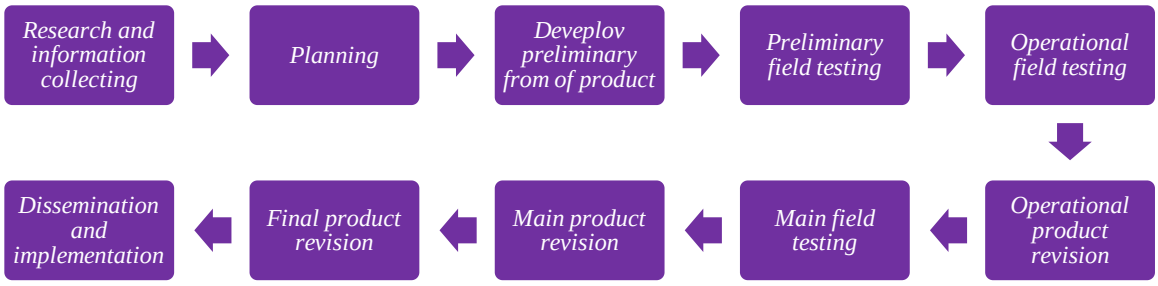

Figure 1. Borg and Gall Research and Development Model

A. *Research and information collection*

The initial step in developing physics learning media in the form of UI/UX-based microlearning is to conduct a literature study of previous research to find potential and relevant problems. The results of the study show that physics learning on thermodynamics material is still difficult for students to understand because it involves abstract concepts and complex calculations. This level of difficulty often triggers misconceptions, which are wrong understandings that are retained for a long time and hinder the process of constructing correct scientific knowledge. Misconceptions that are not properly addressed also have an impact on the low computational thinking skills of students, because they tend to rely on memory alone without understanding the patterns, logic and structure of concepts in depth. Microlearning based on UI/UX as one of the learning technology innovations shows significant potential in improving learning effectiveness. Microlearning is designed to present learning materials in a short duration, focused, easily accessible, so that learners can understand the core gradually and efficiently. When combined with intuitive and interactive user interface and experience (UI/UX) design, microlearning is able to provide a more engaging, adaptive learning experience and encourage learners' active involvement in understanding complex physics concepts.

B. *Planning*

After identifying the potential and problems related to misconceptions in physics learning, especially in the context of developing UI/UX-based microlearning with a computational thinking approach, the next step is to collect supporting data to design appropriate learning media. The data in this study were obtained through the results of a literature study of the learning process to strengthen the basis for media development and ensure its suitability for the needs of students.

C. *Deveplov preliminary from of product*

In this research, there are several stages in designing UI/UX-based microlearning learning media, including the following:

Figure 1. Product Design Stages

RESULT AND DISCUSSIONS

Result

The result of product development that has been done in this research is in the form of UI/UX-based microlearning learning media on physics learning. This research reveals that the development of learning media is carried out through a number of systematic steps. The initial stage focuses on identifying gaps and opportunities in physics teaching through literature review. The results show the potential of implementing microlearning based on UI/UX principles in preventing student misconceptions in physics learning. However, this study also identified challenges in the form of limited learning innovations applied by teachers in teaching physics and less than optimal impact in preventing misconceptions in physics learning.

The second step was to conduct a comprehensive literature review. The aim was to strengthen the theoretical basis of the research and ensure the relevance of the material to be presented in the learning media. The material that became the main focus was thermodynamics.

In addition, this stage also involves identifying supporting resources such as images, audio and animated videos needed to present the material in an interesting and interactive manner.

Product design is made according to learning outcomes, learning objectives, flow of learning objectives, and indicators based on the current curriculum. The process of making learning media by preparing thermodynamic material that wants to be displayed on UI/UX-based microlearning content and then compiling a script which will be used as a guide in the design process on the canvas feature.

SKRIP MEDIA PEMBELAJARAN MICROLEARNING – SZA ADVENTURE IN TERMODYNAMIC

Tahap Pembelajaran	Aktivitas Peserta didik	Deskripsi Media Figma	Tujuan Pembelajaran
Stimulasi (pemberian rangsangan)	Menjelajahi adegan awal berupa mesin uap misterius di pabrik tua	Tampilan Figma menampilkan ilustrasi interaktif dengan narasi visual tentang mesin uap dan percikan api yang menjadi awal petualangan	Membangkitkan rasa ingin tahu dan mengaitkan konsep Hukum I Termodinamika dengan fenomena sehari-hari
Identifikasi	Mengamati ledakan mesin uap dan mencatat anomali yang terjadi (mengapa mesin bisa meledak?)	Media Figma menunjukkan ilustrasi animasi interaktif ledakan mesin uap, lalu munculah info pop-up tentang perubahan energi dan kalor	Mendorong siswa berpikir kritis, mengenali konsep kerja mesin uap dan kaitannya dengan prinsip termodinamika
Pengumpulan dan pengolahan data	Menyusuri bagian mesin dan menemukan clue tentang proses-proses termodinamika seperti isokhorik, isobarik, isothermal, dan adiabatik	Figma menyediakan jalur petualangan interaktif (mirip map RPG) yang setiap check point-nya menyajikan penjelasan proses termodinamika secara mikro (infografis, ilustrasi, video pendek)	Menyediakan pemahaman visual dan konseptual mengenai berbagai proses termodinamika
Menarik kesimpulan	Meringkas jenis-jenis proses termodinamika dan menghubungkannya	Tugas di Figma: menyeret potongan informasi ke dalam diagram energi untuk	Menguatkan pemahaman konsep Hukum I

Figure 3. Making Microlearning Script

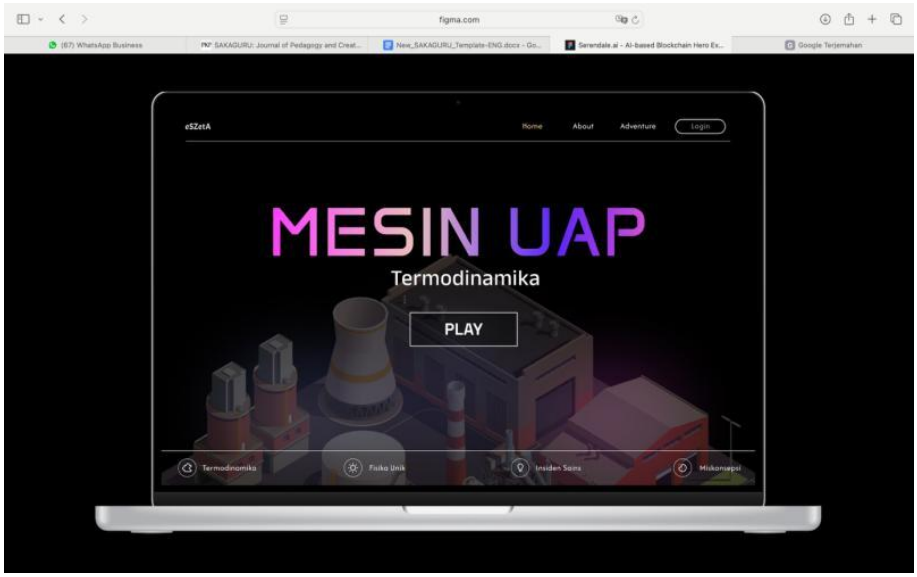

Figure 4. Initial Menu Display

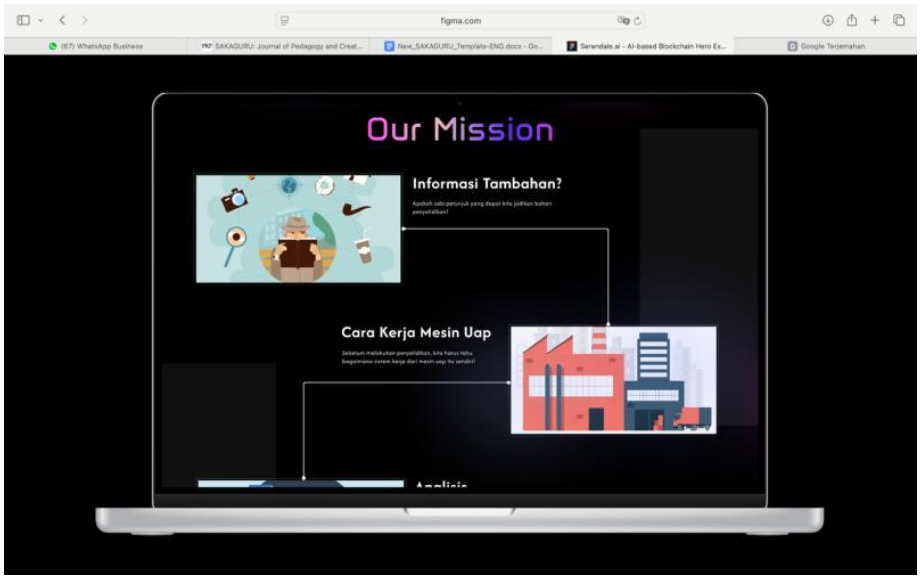

Figure 5. Menu Map

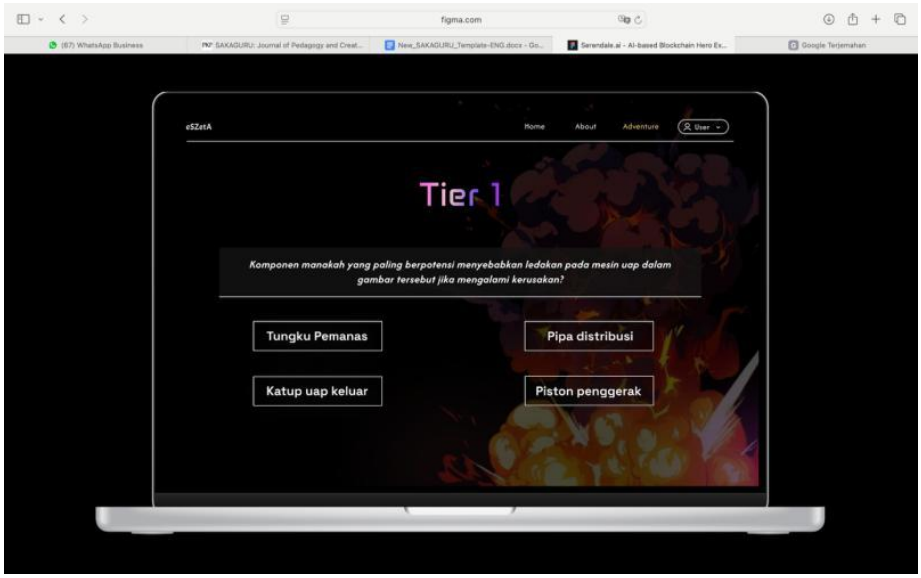

Figure 6. Misconception Measurement Tool and CT

Discussions

This research develops UI/UX-based microlearning learning media with a computational thinking approach to prevent misconceptions in physics learning. The development of microlearning based on User Interface (UI) and User Experience (UX) principles provides an opportunity to present material visually, interactively, and intuitively, and is designed to be learned in a short time so that it can reach the way of thinking and learning of the digital generation [15]. This is in line with research [16] which states that microlearning allows students to be more focused and actively involved in the learning process, thus increasing their cognitive engagement. This development uses Figma as an interactive prototype design platform that enables user-based design collaboration. Figma was chosen because of its ability as a cloud-based design platform that supports the visualization of abstract physics concepts through simple illustrations and animations that can reduce potential misconceptions. In addition, Figma provides features of auto-layout, prototyping, and reusable

components that allow the preparation of non-linear navigation flow which is in accordance with the needs of students in choosing learning topics flexibly [17].

UI/UX-based microlearning development using Adobe XD and Sketch has significant differences compared to other platforms. Adobe XD can create UI designs and interactive prototypes in one platform and supports microinteractions and auto-animation for realistic prototypes [18]. However, Adobe XD is not available in the web version so it must be installed on the device [19]. Then, free use of Adobe XD is limited so premium features such as real-time co-editing require a Creative Cloud subscription. On the other hand, Sketch can only be used for Mac so it cannot be used for Windows or Linux users. In addition, the prototyping features offered are limited to simple interactions, so advanced interactivity requires additional tools [20][21].

The main advantage of UI/UX-based microlearning is designed by displaying a variety of contexts of science incidents and interesting interacting visualizations, thus creating a learning experience that is not monotonous. This diversity of content allows them to learn physics concepts in various relevant contexts and fosters their curiosity. In addition, the media is equipped with a systematically designed misconception measurement tool to detect learners' misunderstanding of key concepts.

Although it offers various advantages, UI/UX-based microlearning has several limitations. One of them is that this research only covers the product design stage, so its effectiveness in preventing physics learning misconceptions cannot be measured empirically. Although figma makes it easy to design a responsive and interactive user interface (UI) prototype, the process of implementing the design into a real application is not entirely straightforward. There are some visual components and transition elements designed in figma that cannot be realized into code directly. In addition, the selection of a color palette that is suitable for visual comfort, especially in the context of delivering complex physics material, requires careful design considerations. Further research is expected to continue Borg and Gall's Research and Development (R&D) until the final stage to comprehensively test the effectiveness of UI/UX-based microlearning, as well as test its impact on various physics learning variables.

CONCLUSION

This research shows that the development of UI/UX-based microlearning learning media with a computational thinking approach has the potential to be an innovative solution in overcoming misconceptions in physics learning, especially thermodynamic material. The integration of intuitive interface design and adaptive user experience allows the delivery of material in a concise, interactive, and easy-to-understand manner, in line with the learning characteristics of today's learners. The use of design platforms such as Figma also supports the visualization of abstract concepts effectively. The computational thinking approach strengthens learners' ability to break down complex concepts into simpler and more logical parts. Although the development is still limited to the product design stage, the results of this study provide a strong foundation for the development of more comprehensive learning media. Therefore, further research is recommended to continue the full R&D stage to test the effectiveness of the media on concept understanding and decrease the level of misconceptions empirically.

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CONFLICT OF INTEREST

"The authors declare no conflict of interest."

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